

# BloodLine

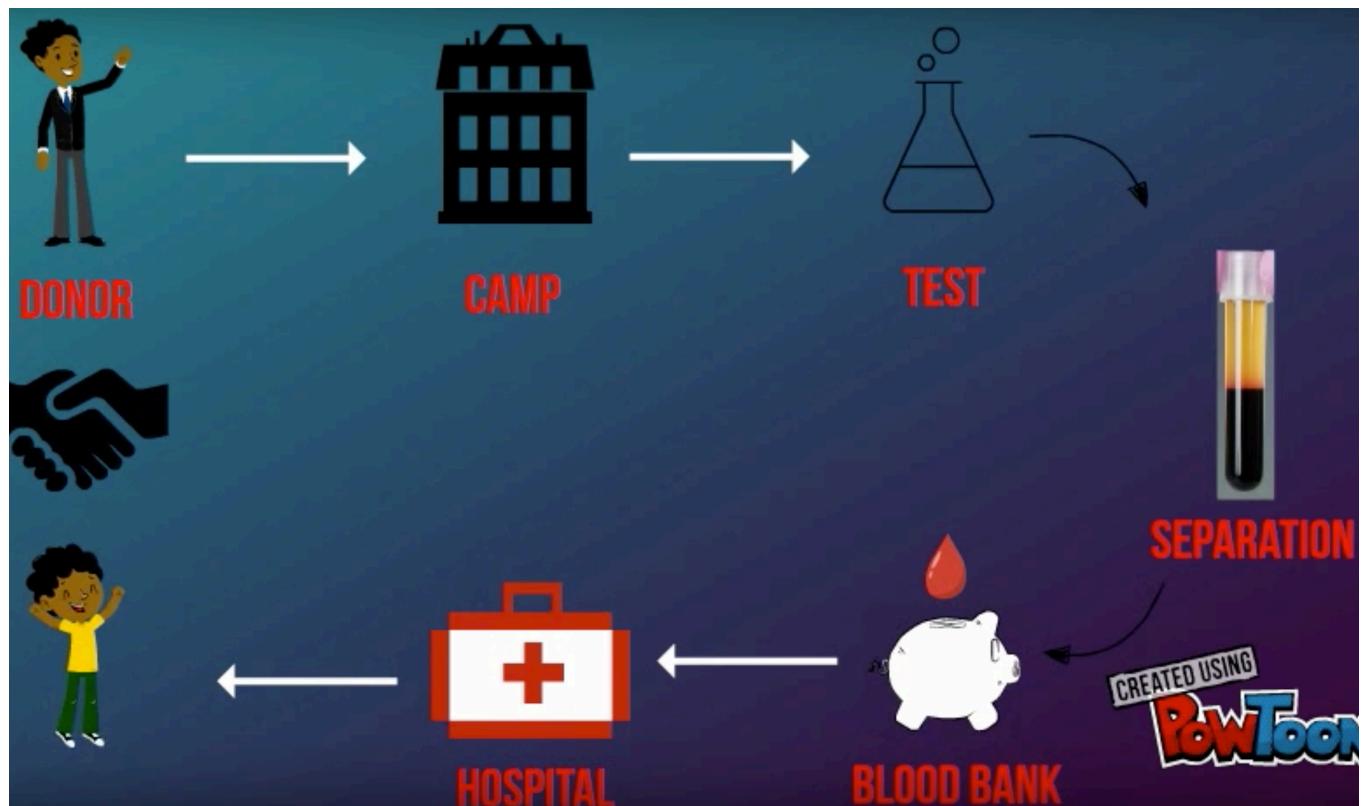
A Blood management solution using BlockChain.

Team 22 - December 12, 2016



## Abstract

The recording of blood donations is done with paper and pen. That is not sufficient for the modern world. In India, in the last 17 months, 2,300 people were infected with HIV / Aids because of mismanagement of blood. There is no proper way to verify the cleanliness of blood donations without testing it yourself. Even if the blood donations are tracked using electronic means like BAR codes, QR codes, unique IDs, there is no consolidated repository for the information of blood which acts like a one stop shop for all the parties involved. Even if there is a consolidated repository that stores all the information about a blood sample, there is no reason for all the entities involved to trust each other, since human error and fraud are an integral part of everyday transactions, both online and offline.



This is where *BloodLine* comes in. It is a demonstration of the management of blood in its journey from donation, testing, separation, and finally to its consumption.

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BloodLine is a web based application that tracks blood donations with blockchain technology. Basically, when blood is donated, every entity along the way updates the blood sample/ packet with details. information on the Blockchain.

When this blood is shipped around to different blood banks and different health institutions, employees can scan the incoming blood shipments to verify they are safe and not contaminated. Any updates to the blood is updated into the blockchain repository

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## Introduction

Blood management is highly vital especially with the advent of a lot of diseases related to blood. In spirit of maintaining a secure and one stop shop for the records of the blood samples that can be updated by all the entities involved and also maintain transparent transactions between each other, BloodLine uses BlockChain technology to achieve that.

Blockchain is a shared, immutable ledger for recording the history of transactions. It fosters a new generation of transactional applications that establish trust, accountability and transparency. It practically allows you to distribute information rather than copying it. This builds a new framework for the internet. Blockchain was originally devised for the digital currency called Bitcoin. Soon, the tech community has found various other applications for the underlying technology behind blockchain.

Simps put blockchain is a leader of transactions that can record not just digital currency transactions, but anything that has value. In our case, Blood.

The key concept behind BloodLine is that the peer-peer distributed network in the world of blood donation and the journey of donated blood is from one non-trusting entity to another non-trusting entity. Bloodline creates a platform for these non-trusting entities to interact with each other without any trusted intermediary in a verifiable manner. From transactional privacy to the expected authenticity of the blood samples and other related metadata, BloodLine tried to eliminate human error and fraudulent transactions thereby reducing the risk of transferring contaminated blood and save countless lives and also easing the process of tracking the journey of donated blood.

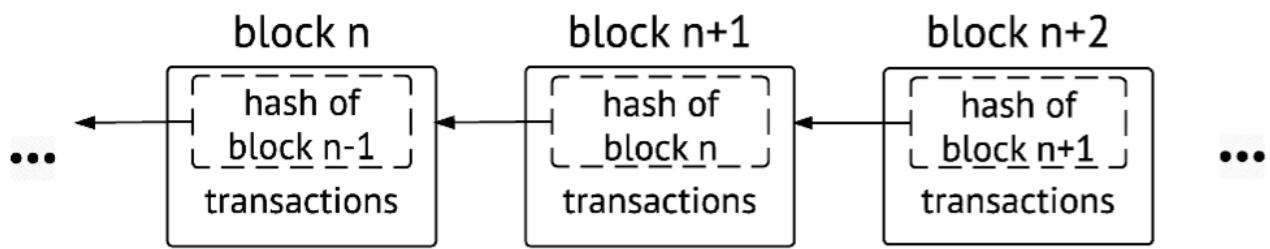
Blockchain has recently taken traction for aspects other than digital currency. Especially when we discovered that we have to manage transactions between a lot of non-trusting parties

## How Blockchain Works?

Simply put, blockchain is a distributed and replicated data structure that is shared among the members of a network.

Multiple nodes connect to a blockchain and make up the network. Each node can make transactional changes

Each block in the chain represents a list of transactions and a hash to the previous block, except for the first block.



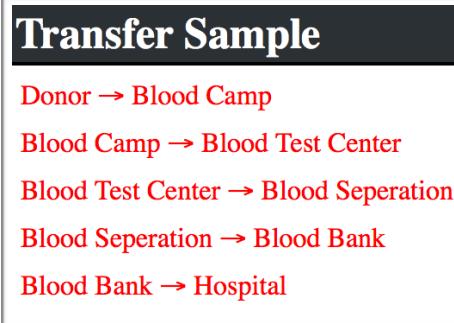
Each block in the block chain are timestamped and each of the block transactions are immutable. Which means the involved parties and entities all across the network can be rest assured that every transaction is immutable and cannot be altered. The block in a block chain is its cryptographic hash. Any entity with access to the linked list can read it and figure out what is the world state of data that is being transferred on the network.

You can trace a transaction back to its roots right from the time when a blood sample has been recorded into the system. So the keyword that we are looking for is "**transparency**".

Another aspect of the blockchain is that once a transaction is committed, it cannot be altered.

## Applications of BloodLine

As explained earlier, the nodes that are involved in block chain network (the blood management system) are as follows. Each of them have transactional control over the blood samples that they receive. They can either update the blood details or they can just transfer the blood samples from one entity to the other.



### **Blood Camp:**

As a representative of the Blood Camp, you will receive blood from various donors. This is the entry point of the blood samples into the journey of donated blood.

### **Blood Test Centre:**

As a representative of the Blood Test Centre, you will receive blood from the Blood Camps and update the block chain with the details of the blood.

### **Blood Separation:**

As a representative of the Blood Separation centre you will separate the RBCs and plasma in the blood.

### **Blood Bank:**

As a representative of the Blood Bank, you will receive blood from the Blood Separation centre.

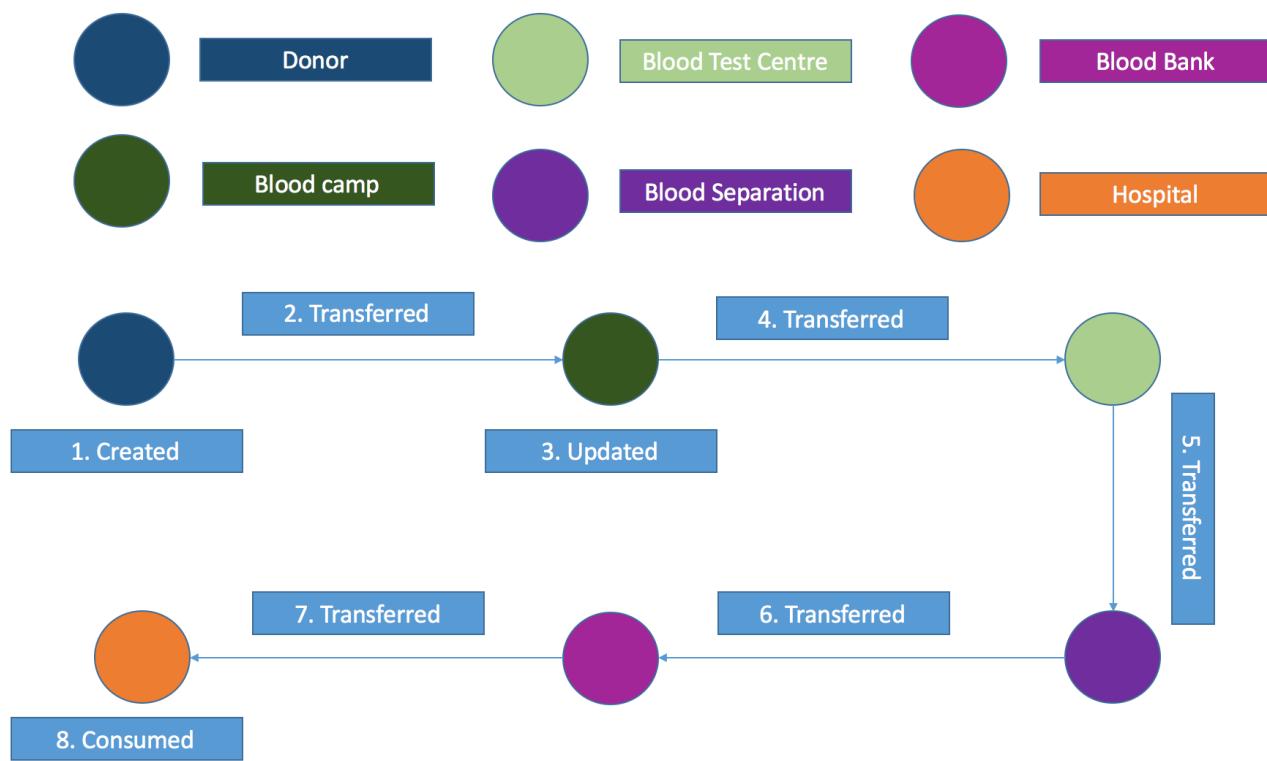
### **Hospital:**

As a representative of the Hospital, you will receive blood from the Blood Bank.

# Application Scenario

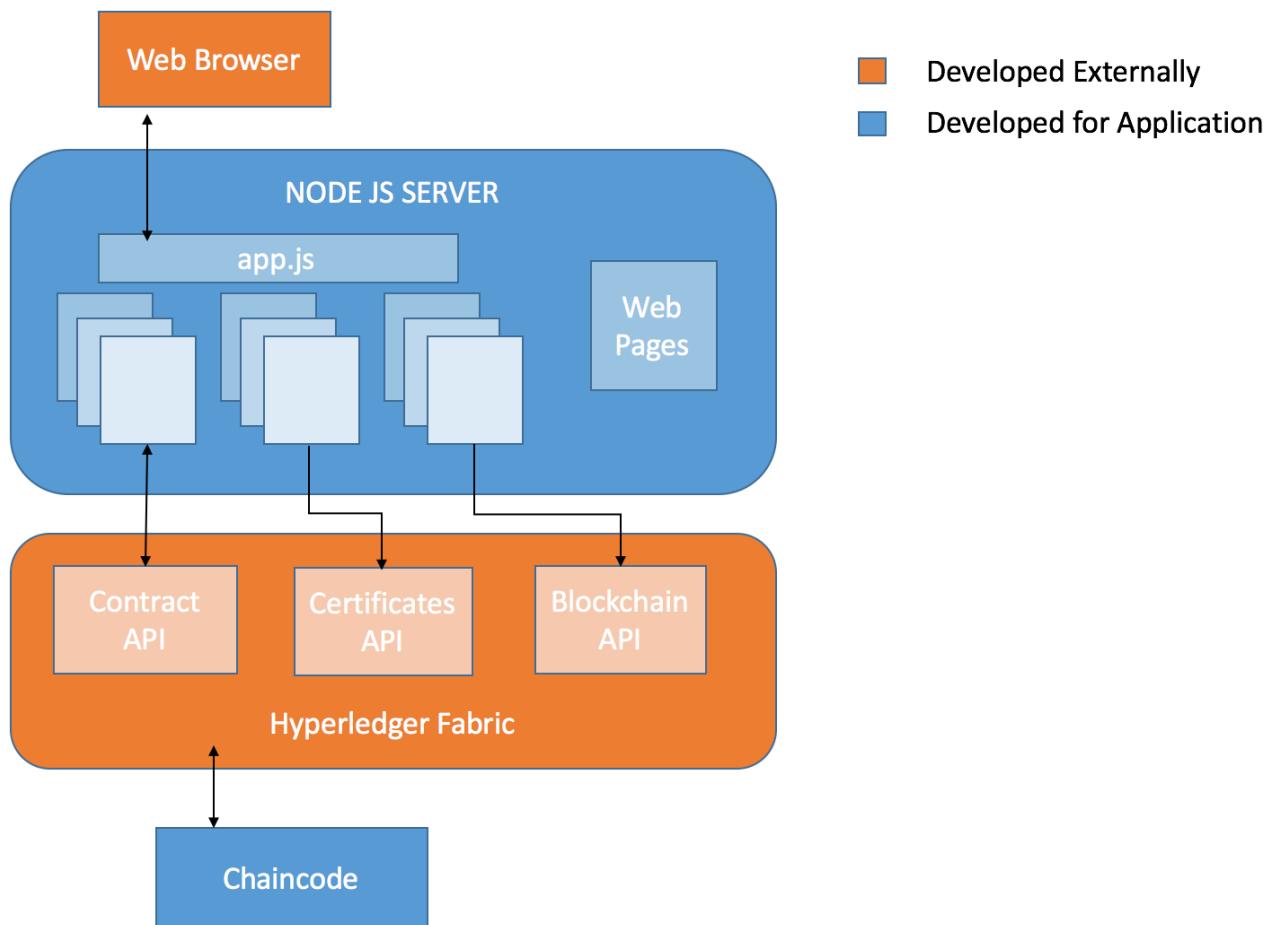
## Stages:

- 1 A Blood Sample is created as a template at the Donor's entry point.
- 2 Blood Sample template is transferred to the Blood Camp.
- 3 Blood Camp updates the blood sample template to define it as blood giving it a group, HIV status, date etc.
- 4 Blood Camp transfers the sample to Blood Test Centre for further tests.
- 5 Blood Test Centre transfers the sample to Blood separation.
- 6 Blood Separation transfers the blood to a Blood bank.
- 7 Blood Bank transfers the blood to a hospital.
- 8 Hospitals supply blood to patients where blood is consumed.



# Architecture

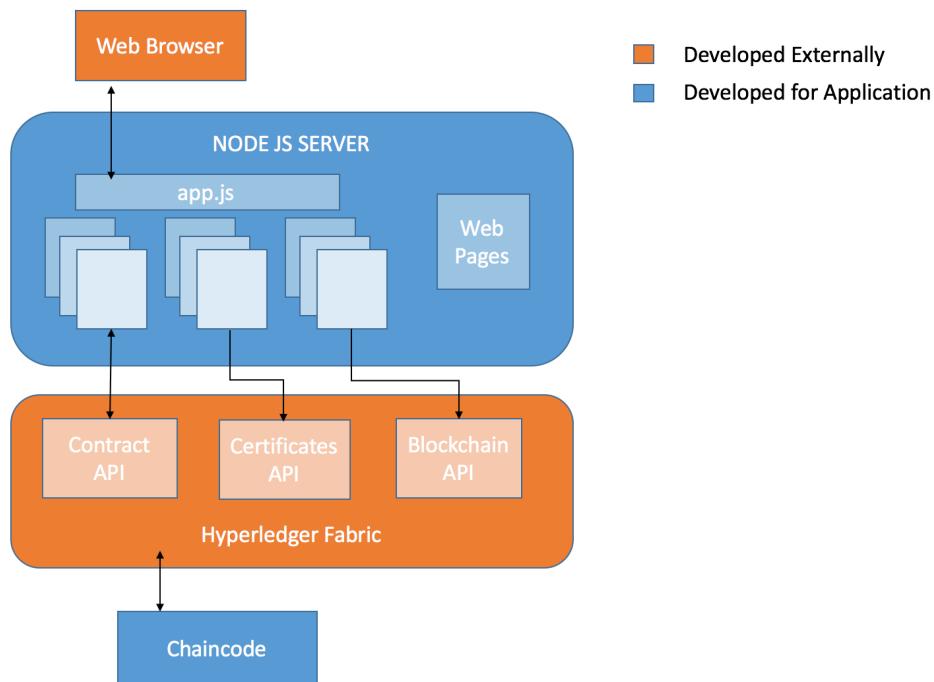
This project uses a 3-tier architecture. The user interacts with the demo using the front end that is provided by the NodeJS server in the middle tier. This web front end uses JavaScript to make HTTP requests to the NodeJS server which has an API which in turn makes calls via HTTP to the HyperLedger fabric to get details about the blockchain and also interact with the chain code.



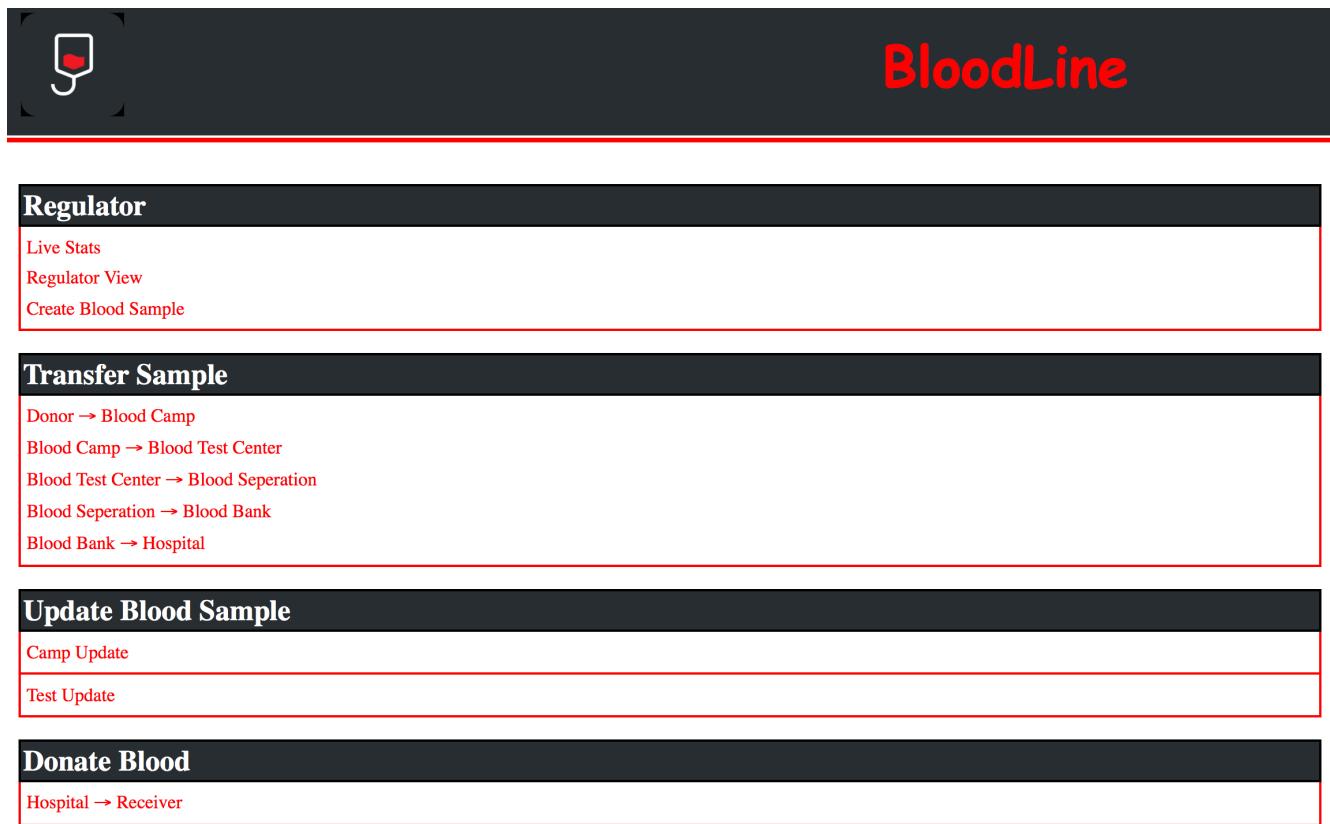
## IBM BlockChain in BloodLine

**Smart Contracts and Chaincode:** The open block that we leveraged use the chain code technology. Chain code extends traditional smart-contracts, broadly defined as self-executing agreements written in code that may be interacted with and may trigger other smart-contracts, but with further capabilities. The Chain-code is executed in Docker containers, and interacts with golang. More importantly, chain-code is immutable, may retain state, and inherits confidentiality and privacy.

**Hyperledger Fabric:** The blockchain was leveraged from the Hyper-ledger Fabric. The fabric is an implementation of blockchain technology which in turn leveraging familiar and proven technologies. It is a modular architecture allowing pluggable implementations of various function. This fabric is how smart contracts are created. The fabric has container technology that gets the smart contracts in action.



# Home Screen



The Home Screen window is broken in the following sections:

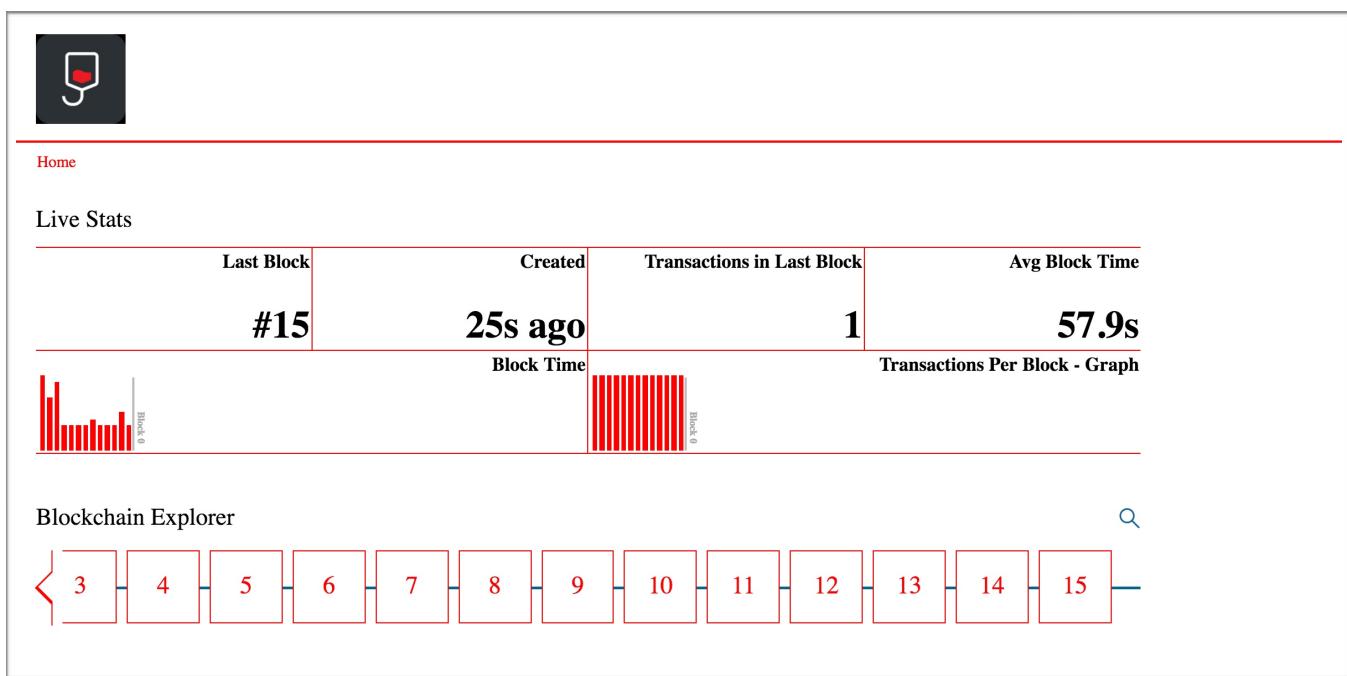
- Regulator
  - Live Stats
  - Regulator View
  - Create Blood Sample
- Transfer Sample
  - ❖ Donor—>Blood Camp
  - ❖ Blood Camp—>Blood Test Center
  - ❖ Blood Test Center—>Blood Bank
  - ❖ Blood Bank—>Hospital
- Update Blood Sample
- Donate Blood

## Blockchain Live Stats

Here is the real time block chain information of Bloodline. You can notice that there are 15 blocks of data that are chained one after the other. Each of those blocks contain hashed transactions of it's own data and the previous block.

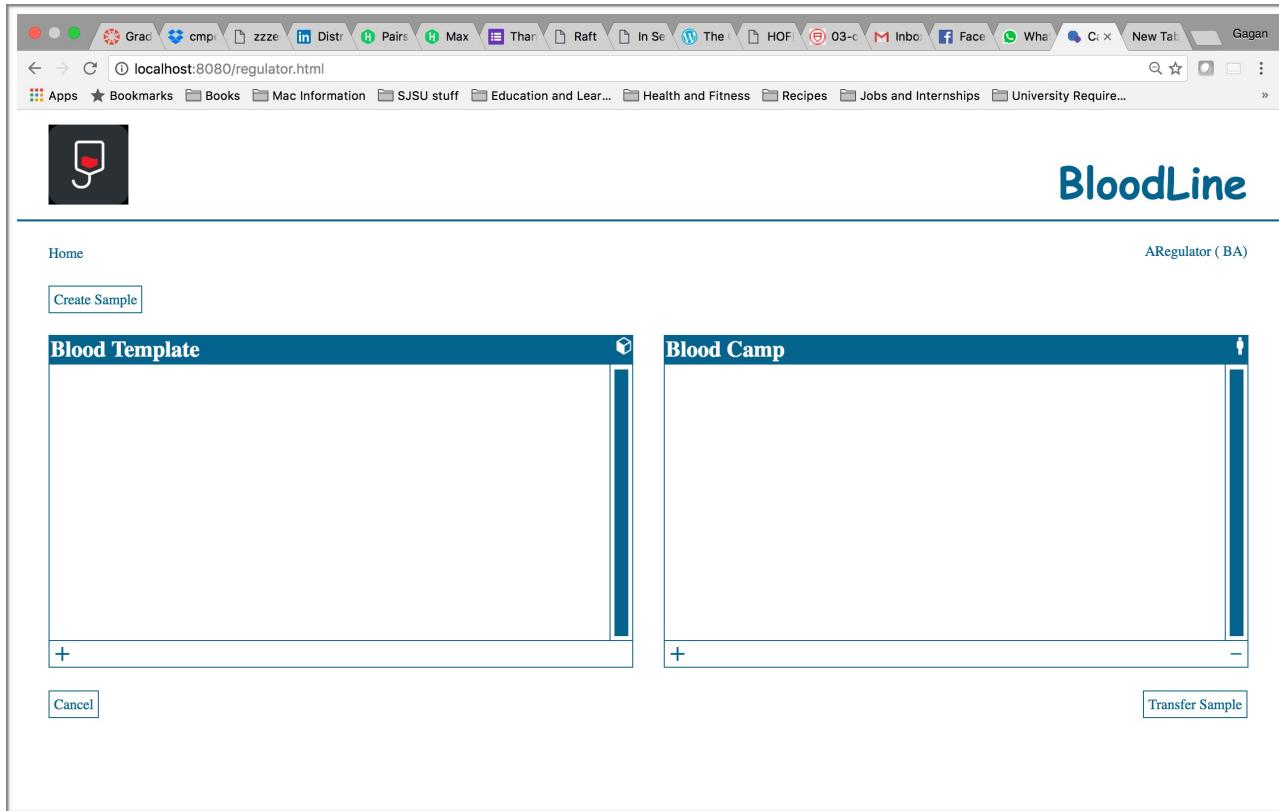
We have also included the number of the Last Block, the time that it was created and the number of transactions in that last block as the the main display data of the live stats. the window also displays the Average Block Time and a graph that emulates the number of transactions per block and the time that each block transaction has taken.

If you choose to examine the details of the block and it's hash, you can click on the block number under the Block Explorer section.

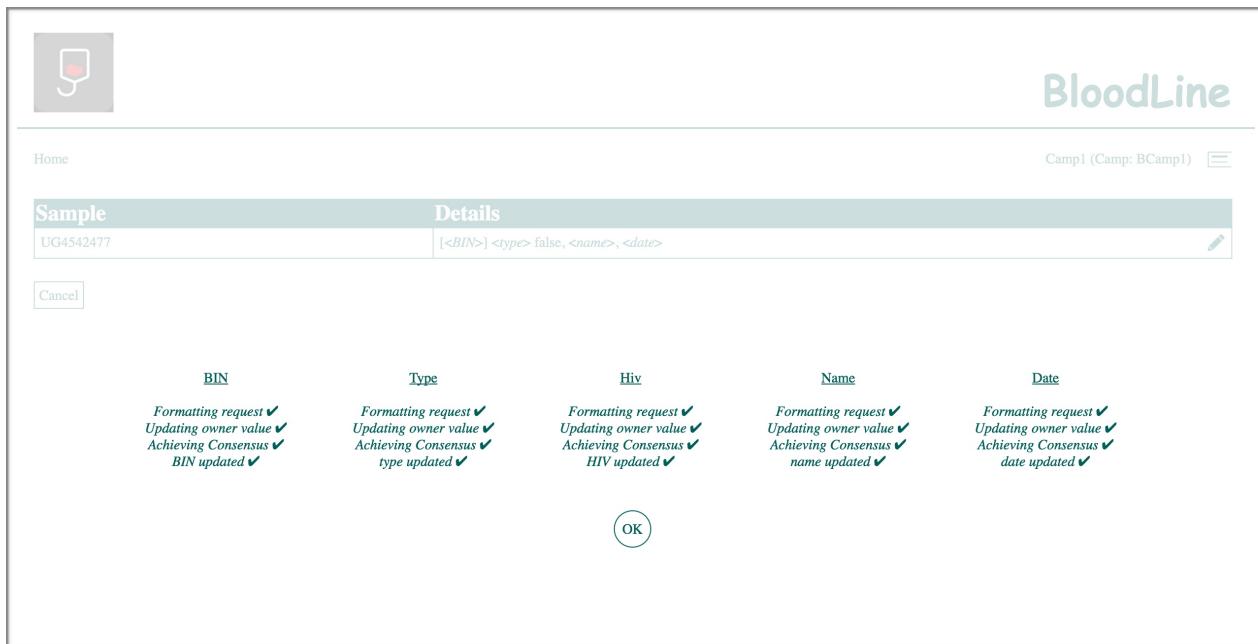


# Creating a Blood Sample

Here is window where a Donor camp representative can create the first sample template of the blood.



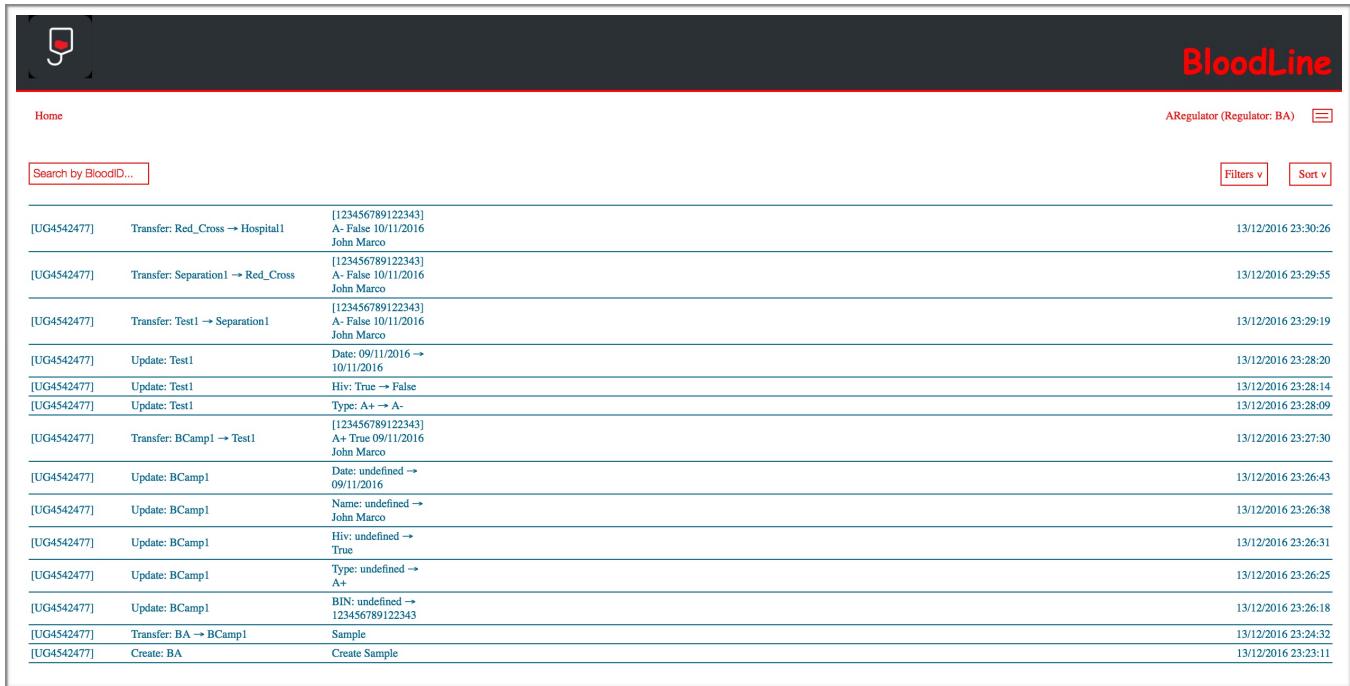
You can notice that once created, the sample can be updated on it's attributes.



# Blockchain Regulator View

Here is the Regulator View. You can land on this page from the Home page. You view the log of the block chain transactions of all the entities involved here. It is more or less a list of each and every transaction update to the blood sample right from the blood sample template to it's consumption.

Notice that every Test Center (Test1...), every Blood Camp (BCamp 1) are listed as part of the transaction. So an admin can trace a blood sample from it's start to end. This reduce fraudulent transactions and minimizes human error too.

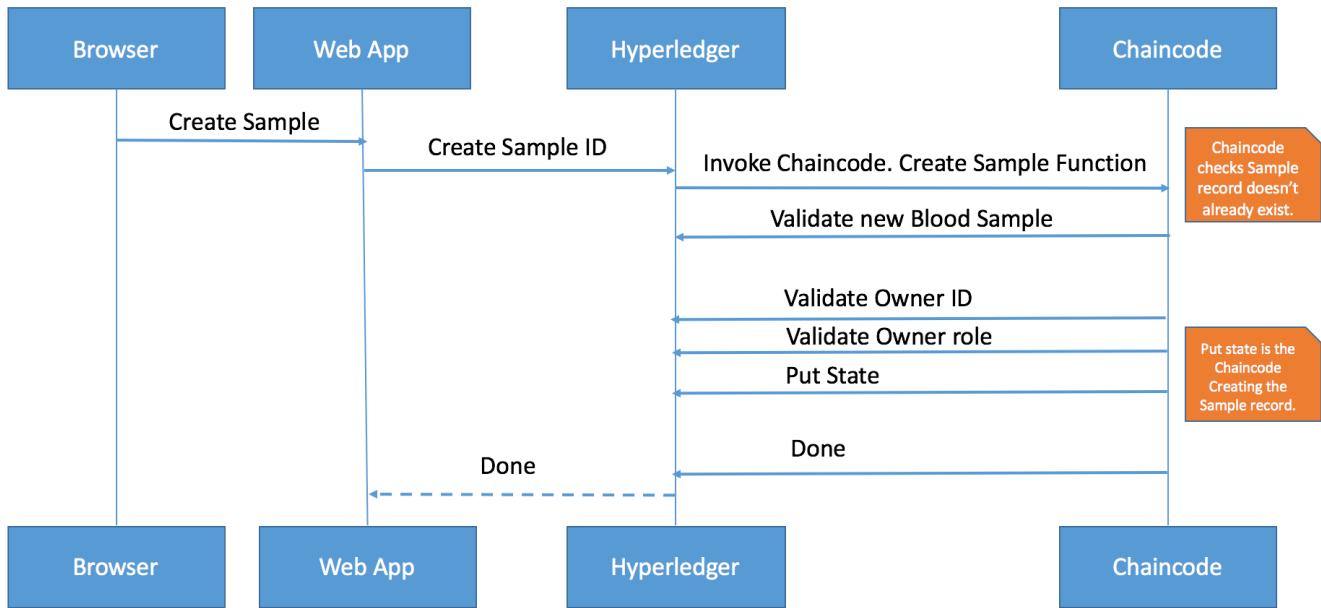


The screenshot shows a web-based application titled "BloodLine" with a dark header bar. On the left is a small logo of a blood drop with a heart. On the right, the title "BloodLine" is displayed in red. Below the header, there are navigation links: "Home", "ARegulator (Regulator: BA)", and a menu icon. A search bar labeled "Search by BloodID..." is positioned above a table. To the right of the search bar are two buttons: "Filters v" and "Sort v". The main content area is a table with the following data:

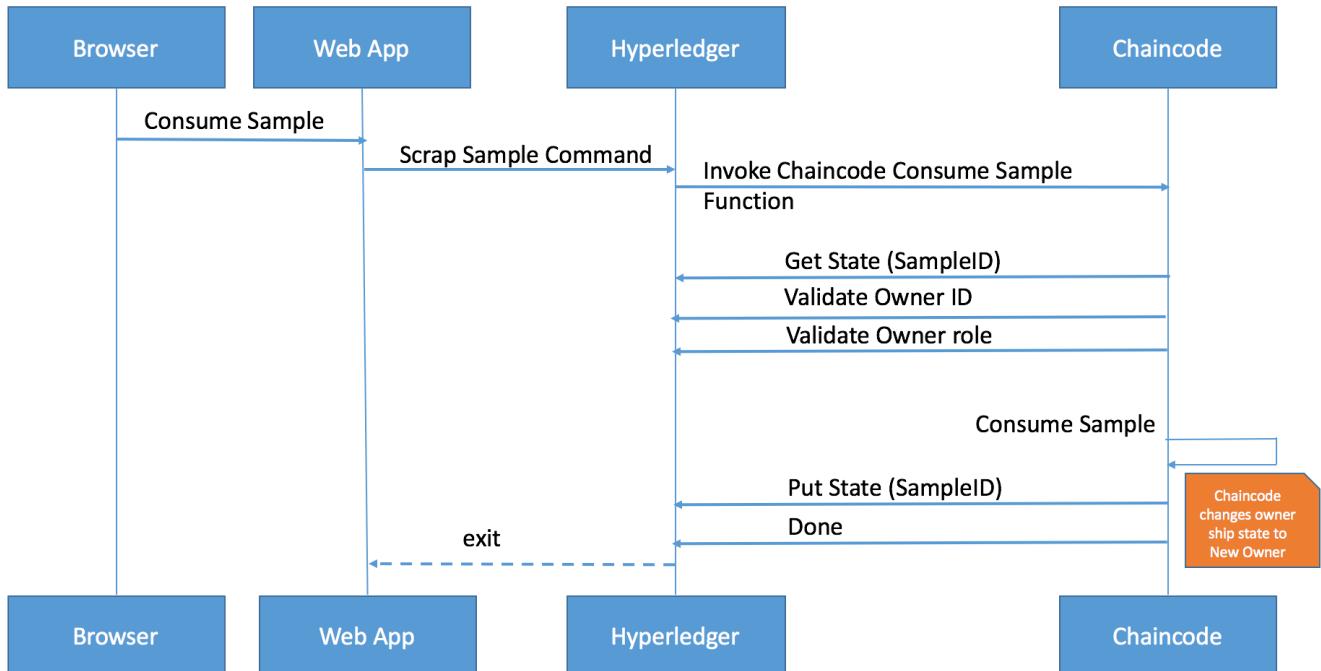
| [UG4542477] | Transfer: Red_Cross → Hospital1   | [12345678912343]<br>A- False 10/11/2016<br>John Marco | 13/12/2016 23:30:26 |
|-------------|-----------------------------------|---|---------------------|
| [UG4542477] | Transfer: Separation1 → Red_Cross | [12345678912343]<br>A- False 10/11/2016<br>John Marco | 13/12/2016 23:29:55 |
| [UG4542477] | Transfer: Test1 → Separation1     | [12345678912343]<br>A- False 10/11/2016<br>John Marco | 13/12/2016 23:29:19 |
| [UG4542477] | Update: Test1                     | Date: 09/11/2016 →<br>10/11/2016                      | 13/12/2016 23:28:20 |
| [UG4542477] | Update: Test1                     | Hiv: True → False                                     | 13/12/2016 23:28:14 |
| [UG4542477] | Update: Test1                     | Type: A+ → A-   | 13/12/2016 23:28:09 |
| [UG4542477] | Transfer: BCamp1 → Test1          | [12345678912343]<br>A+ True 09/11/2016<br>John Marco  | 13/12/2016 23:27:30 |
| [UG4542477] | Update: BCamp1                    | Date: undefined →<br>09/11/2016                       | 13/12/2016 23:26:43 |
| [UG4542477] | Update: BCamp1                    | Name: undefined →<br>John Marco                       | 13/12/2016 23:26:38 |
| [UG4542477] | Update: BCamp1                    | Hiv: undefined →<br>True                              | 13/12/2016 23:26:31 |
| [UG4542477] | Update: BCamp1                    | Type: undefined →<br>A+                               | 13/12/2016 23:26:25 |
| [UG4542477] | Update: BCamp1                    | BIN: undefined →<br>12345678912343                    | 13/12/2016 23:26:18 |
| [UG4542477] | Transfer: BA → BCamp1             | Sample  | 13/12/2016 23:24:32 |
| [UG4542477] | Create: BA                        | Create Sample   | 13/12/2016 23:23:11 |

# Use Case Diagrams

## Create Blood Sample:

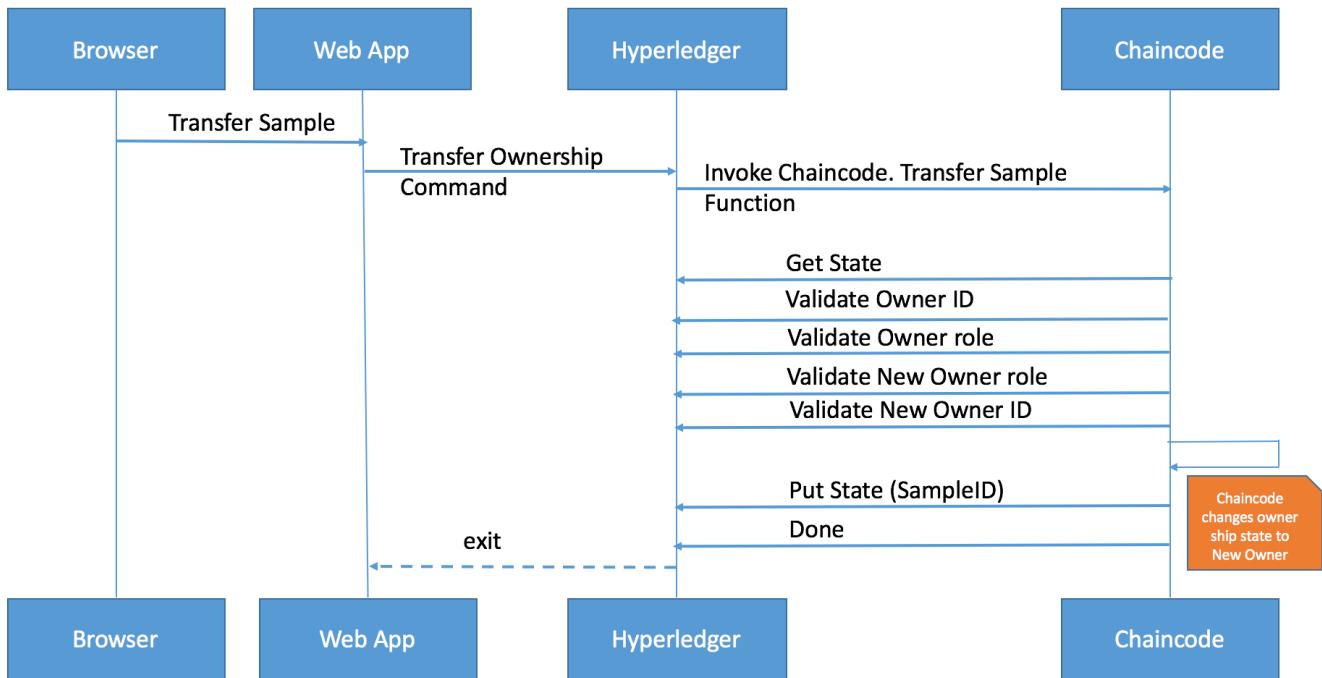


## Consume Blood Sample:

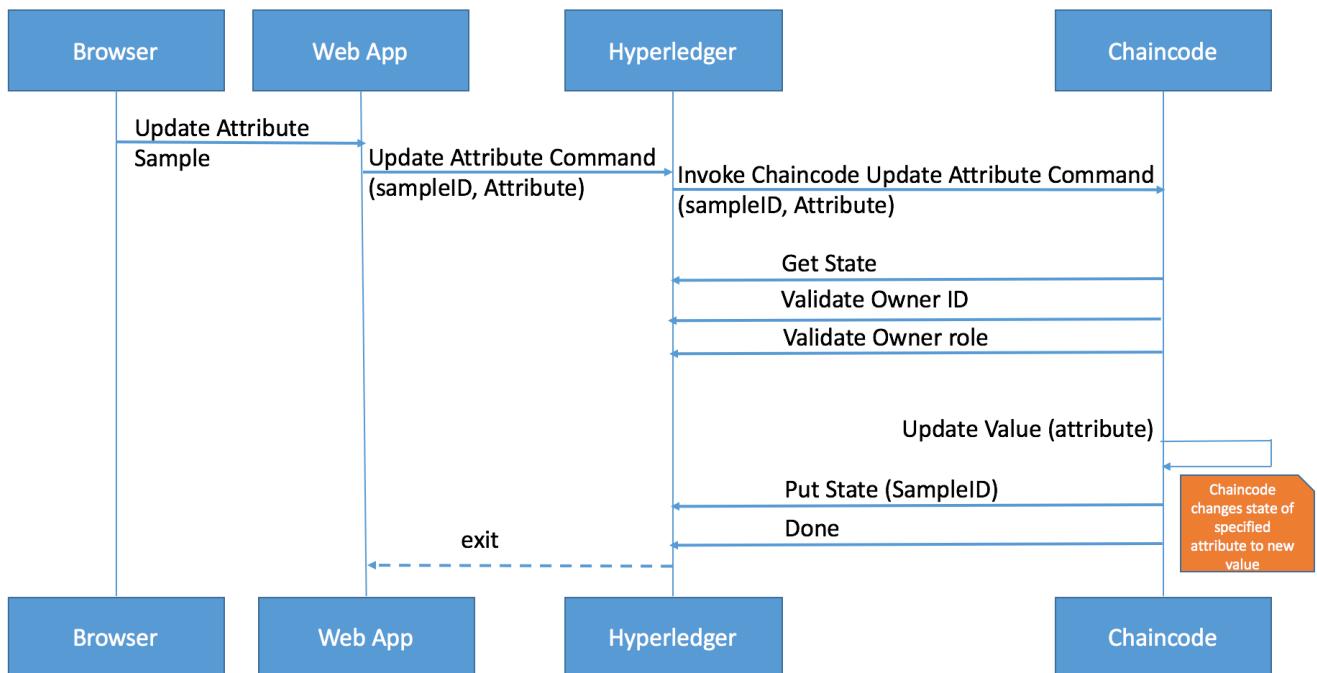


## Use Case Diagrams...Contd

### Transfer Blood Sample



### Update Blood Sample:



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## References

IBM Blockchain Resources  
The Hyperledger Project